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ABSTRACT

A study examined a series of seven experiments conducted in order to identify more precisely the hierarchical structure of the concept emotion, which presumably extended from superordinate to basic and finally subordinate levels. Subjects, 1,052 persons in all, participated in any of seven different experiments: (1) listing basic level categories of emotion (145 subjects); (2) generating superordinate categories (127 subjects); (3) assessing prototypicality ratings of key emotions (90 subjects); (4) measuring reaction times of key emotions (60 subjects); (5) judging substitutability of key emotions (320 subjects); (6) discerning inductive generalizations with key emotions (180 subjects); and (7) determining family resemblance scores with key emotions (140 subjects). The more direct measures of prototypicality were subsequently compared in a correlation matrix. Results indicated that all but one measure of prototypicality were highly intercorrelated. Also, it would appear that the concept of emotion follows a Roschian type of membership classification similar to other natural object categories. Though other competing approaches have been proposed, none have provided the empirical data that the prototype analysis has done in the attempt to specify the taxonomy of categories (whether emotion or natural object). The classical theory, at its best, has only limited usefulness in particular categories. (Fifty-four references and 13 tables of data are attached.) (RAE)

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Prototype Perspective

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Understanding the Concept Emotion: Support for a Prototype Perspective

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Abstract

The experiments presented here were a continuation of those executed by Fehr and Russell (1984) where members of the concept emotion could be effectively categorized along a continuum of better to poorer instances rather than by a defining set of individually necessary and jointly sufficient attributes. In our first studies, a number of emotions were generated by subjects. Sixteen of these were subsequently selected as key types on the basis of their varying availability and prototypicality. Further research indicated that the more typical types were verified as emotions faster than poorer examples, were more effectively substituted for the superordinate name emotion in natural sounding sentences, and possessed higher family resemblance scores. One exception to this trend was that inductive generalizations to other key terms did not differ when central and peripheral members were used as the textual instances. Based on the overall results, however, it would appear that emotion (as well as other concepts) could be better understood by adopting a prototype perspective rather than the traditional classical view.

Understanding the Concept Emotion:
Support for a Prototype Perspective

According to Eleanor Rosch and her colleagues (1976), the world does contain "intrinsically separate things" (p. 383). That is, the world is structured around objects that have their own uniquely different characteristics or attributes. For example, animals with feathers will probably have wings as well, as opposed to animals that have fur.

Not only is there structure in the world but also a "cognitive structure" in the perceiver to be aware of these sets of real-life attributes. Categorization is one type of cognitive structure which allows the perceiver to dissect the environment into a number of objects that can be considered equivalent on the basis of their shared attributes. For instance, the perceiver can mentally divide the world of animals into the "birds" (i.e., those creatures that can fly, have wings and feathers, lay eggs, and so on) and the "nonbirds" (i.e., those creatures that do not possess these features). It would appear that the structure of the real world not only interacts with the

perceiver's classification of objects but also contributes to category formation and development (Rosch, Mervis, Gray, Johnson & Boyes-Braeum, 1976).

Now cognitive psychologists have deliberately raised questions about the internal structure of the perceiver's categorizations. Two views of mental categories based on particular attributes of objects have been presented in the literature: the classical definitional view and the prototype view.

Classical View

The first approach toward defining concepts is Aristotelian in nature and asserts that members of a category possess a small set of critical features. Further, the classical view suggests an all-or-none criterion for category membership: for an object to be a member, it must have all the defining features of that category. According to this approach, to be categorized as a square, the object must possess the following defining features: (a) four sides, (b) four angles, (c) all sides equal, and (d) all angles equal. Each of these features is singly necessary: if an object is to be designated "square," it must have that feature.

Moreover, the four features are jointly sufficient in that an object possessing all four attributes will be automatically designated "square." If a geometric object even deviates slightly from these defining criteria, placement in the "square" category will not occur (Smith & Medin, 1979).

It is apparent that once the perceiver has learned the category, determination of membership is a simple process solely dependent on an object possessing all the necessary and sufficient attributes. The classical view would further imply that the members of each category are homogeneous, and that the category boundaries are distinct with few or no ambiguous members. Categories (and concepts) can thus be pictured as "pigeon holes" in the mind, with each member falling into only one of these holes (Fehr & Russell, 1984).

Though some categories can be successfully defined by the classical view (e.g., odd and even number, square and triangle), many researchers apparently are doubting the validity and usefulness of this approach to describe the structure of all concepts. Armstrong, Gleitman and Gleitman (1983) and others (Rosch & Mervis, 1975) indicate the difficulty in identifying lists of critical

features for common object categories such as birds, fish, flowers, trees, furniture, clothing, and so on. And even if some of the relevant properties are omitted from these lists, assignment to the appropriate category remains unaffected. For instance, an ostrich can still be classified as a "bird" even though it does not fly. Therefore, another approach, the prototype view, has been advanced by several researchers as a reasonable alternative to the problematic classical model.

Prototype View

According to this view, a category is once more specified in terms of its features. However, as Wittgenstein (1953) first argued, these features need not be necessary and sufficient for categorical membership. Rather, it is the degree to which the features resemble each other that determines membership (as relatives in a family are identified by their degree of similarity to each other). Taking the concept "game," one finds that there is no single defining feature that all games have in common. Still, most games resemble each other due to their sharing some gamey attributes, such as being fun, having rules, and involving an element of play.

Rosch (1973a, 1973b) has elaborated on Wittgenstein's description by suggesting that category membership is determined by resemblance to a prototype. By definition, a prototype is the best instance (or clearest example) of that category for it possesses all the typical features. Neisser (1979) would even go so far as to say that the truly prototypical instance is one that is not directly observable in the environment but a "hypothetical ideal" imaged by the perceiver. To provide a Roschian example, a prototypical chair displays the following properties: a man-made piece of furniture that is movable, has a horizontal surface with a vertical back attached, has four legs to support this surface, and has a functional use — to sit upon. Other category members presumably vary in the degree to which they resemble this prototype, from more prototypical to less prototypical chair instances (curved seats and recliners) to finally noninstances (sofas and couches). Certain types of perceptual categories (color, form and line orientation) as well as more natural object categories (e.g., bird, fruit, vegetable and vehicle) would appear to possess this type of internal structure, whereby members can be ordered from better to poorer examples based on the prototype to

which they refer (McCloskey & Glucksberg, 1978; Rosch, 1973a, 1973b, 1975a, 1975b, 1975c).

Handling Criticisms of the Classical View

Rosch's assumption of correlated features to a prototype addresses many of the problems left unanswered by the classical approach. First, since categories do not have defining features, the search for critical attributes does not have to continue. Second, the lack of defining features implies that categories do not have distinctive but rather "fuzzy" boundaries; namely, ambiguous members may exist if they do not share many of the features in common with the prototype. For instance, fig and olive are less fruity than apple and strawberry, and would be classified by subjects as borderline cases. Third, the prototypical view allows category members to possess heterogeneous features; some members may have most of the prototypical attributes while others may possess very few of the attributes. Finally, because some members may be more typical instances of the categorical prototype, classification would employ a graded criterion rather than the rigid all-or-none law (Cantor, Smith, French & Mezzich, 1980).

Hierarchical Structure to Concepts

Rosch and her colleagues (1976, 1977, 1978) further discovered that many natural categories exhibit a hierarchical organization at least three levels deep ranging from superordinate to middle to subordinate. Categories at the middle level are more "basic" than those above or below because they contain the richest prototypes. Assigning an object to a general or superordinate category (e.g., furniture) imparts little information as to its prototypical features, while designating the object to a basic category (e.g., chair) provides the most descriptive information. Moving the object to an even more specific or subordinate category (e.g., armchair) does not add much more detail to the basic level prototype.

Rosch suggests that the basic categories do not only contain the richest prototypes but the most distinctive ones as well. These categories are not as highly specific as the subordinate, and so do not share overlapping features with many contrasting categories (e.g., the subordinates kitchen chair and dining room chair are not very distinctive). In addition,

basic-level categories are the first classifications made during perception of the environment, are the earliest categories named by children, and are the most coded. Thus, natural objects will be the most effectively categorized at the basic level, for this is where the best types of prototypes can be found (Mervis & Rosch, 1981; Rosch, 1976, 1977, 1978).

Additional studies have demonstrated that other concepts can be correlated to prototypes like the common object categories. Intelligence, aspects of the self, personality disposition, even abnormal disorder classifications apparently lack precise definitional criteria, following instead the levels of prototypic arrangement postulated by Rosch (Buss & Craik, 1980, 1983; Cantor & Mischel, 1977, 1979; Cantor, Smith, French & Mezzich, 1980; Horowitz, Post, French, Wallis & Siegelman, 1981; Horowitz, Wright, Lowenstein & Parad, 1981; Neisser, 1979; Rogers, Kuiper & Kirker, 1977).

The Concept Emotion

The two approaches, classical and prototype, have been further employed to understand the often-used concept of emotion. However, when each of the classical definitions is examined, one finds the criteria so broad

or inadequate that many psychological concepts (i.e., motives, attitudes, even cognition) would be classified with the label "emotion."

Classical Views

Young (1936, 1943, 1961) and others (Boring, Langfeld & Weld, 1939) first viewed emotion as an acute "disorganized response" in which visceral processes, behavior and conscious experience were all disrupted. What supposedly distinguished emotion from other states such as moods, affects and temperaments was the brief intensity of the disturbance. In critiquing the disorganization concept, Leeper (1948) suggested that the disruptive quality of emotion was not chaotic or haphazard, but enabled the organism to engage in a new "highly organized and directed activity" (p. 17) that had survival value. This major activity apparently replaced more subordinate functions the organism was previously performing. However, the result of Leeper's argument was to make the category so inclusive that any process which aroused, sustained and directed activity could be a potential member.

Another strategy has been to regard emotions as primarily motor-expressive, involving "facial responses"

mediated by a neurophysiological base. Izard (1971, 1972) identified eight to nine fundamental emotions based on their distinct facial expressions; the list included such emotions as joy, distress, anger, disgust and fear. All other 'secondary' emotions were combinations of these primary states. An interesting interpretation provided by Izard was that the emotional reaction involved no cognitive processes, but rather was governed by inherently adaptive functions to survive within the environment (reminiscent of the Leeper position). Alternatively, Mandler (1975) has adopted a cognition-arousal theory of emotion in which autonomic activity not only stimulated "mental analysis" but was a direct product of cognitive evaluations and appraisals of the situation. Schachter (1964) even suggested that the experience of emotion was exclusively controlled by a person's conceptualizations, that is, the way the person categorized and labeled his or her own state. The debate concerning the topic 'what is emotion: mental process or physiological activity?' has extended back to Greek times and is still continuing today. One has only to compare Solomon's (1977) mental event approach to Tomkins' (1980) facial pattern theory to see that the issue has not been resolved by the

classical view.

The type and number of emotions have also generated a good deal of controversy. Panksepp (1982) has proposed four distinct neural systems of emotion. The magical number 'eight' (plus or minus two) has been chosen by other researchers to designate the set of basic affects (Izard, 1971; Plutchik, 1962, 1980; Tomkins, 1962). In addition, one notices that few (if any) positive emotions belong to these primary groups. For instance, Panksepp's four systems included three negative emotions (rage, fear and panic) and only one very controversial positive type, namely expectancy. As Averill (1980) had indicated, the reason that a 'paucity' of positive emotions exists is that there are basic problems with the way we have defined emotion. Most descriptions in the past have included negative connotations; affective behavior was regarded as intense, persistent, irrational, impulsive, even uncharacteristic of the individual. Therefore, while attempts have been undertaken to identify major characteristics of the concept emotion, many positive states have been subsequently excluded from membership.

Due to the inherent problems with the classical

approach, several psychologists have urged that the everyday concepts of emotion be abandoned and the new ways of conceptualizing affective phenomena be explored (Brooks, 1978; Duffy, 1934; Kagan, 1978; Smith & Medin, 1981). Features of the category "emotion" would appear to lend themselves more readily to a prototypical type of organization, extending along a continuum from most typical instances to least typical (Averill, 1980; Fehr, 1982; Leeper, 1948; Russell, 1980). Moreover, the lack of sharp boundaries found between emotional and nonemotional states is further supportive of the prototype analysis (Duffy, 1941). Finally, the consistent trend in the literature to cite primary sets of emotions might be an indication that these basic types are representative of the richest and most distinctive affective prototypes (Plutchik, 1980).

A New Approach: Prototype Analysis

Fehr and Russell (1984) were the major researchers that directly applied the prototype perspective to the concept of emotion. Their first experiments showed that basic level emotions such as happiness, fear, envy, and awe could be generated when the superordinate name

emotion was presented, and that these basic types could be reliably ordered from better to poorer examples of emotion. Further research confirmed their hypothesis that the degree of prototypicality of these basic types was correlated with how likely these terms could be substituted for the word emotion in sentences without losing their natural sounding quality. Moreover, central types (e.g., happiness, anger, excitement, and joy) generated less controversy among subjects about categorical membership than the peripheral types (e.g., envy, calmness, boredom, and awe), suggesting that emotion did not have distinct, clear-cut boundaries. Finally, the more prototypical types had a higher degree of family resemblance, that is, shared more of the attributes possessed by other members. Some of these shared features consisted of the following: "obsessive concern with a situation," "increases in heart rate," "staring eyes," "tensing of muscles," and "sweating/perspiring" (p. 479). Based on these overall results, Fehr and Russell concluded that Rosch's predictions about the internal structure of categories were very applicable to the concept of emotion, and that emotion could be better understood by adopting

a prototype perspective than the traditional classical view.

We conducted a further series of experiments in order to identify more precisely the hierarchical structure of this concept, which presumably extended from superordinate to basic to finally subordinate levels. Following the format of Fehr and Russell, we first allowed subjects to list as many types of emotion as possible and then asked them to determine, on a rank-ordered scale of prototypicality, which members were better or worse instances of emotion. It was hypothesized that more prototypical types (a) would be verified as emotions faster than poorer examples, (b) could be effectively substituted for the superordinate name emotion in naturally occurring sentences, and (c) would have higher family resemblance scores, replicating past findings (Fehr & Russel, 1984; Fehr, Russell & Ward, 1982). Moreover, such prototypical members (d) would permit inductive generalizations concerning the nature of emotion to be made more easily to peripheral instances than vice versa, supporting the research by Rips (1975) and others (Rips, Shoben & Smith,

1973) on natural object categories. Altogether, these studies yielded a more accurate mapping of emotion into its constituent and distinctive levels of categorization. And the subjects that were tested in these experiments were all undergraduates of Illinois Benedictine College in Lisle who participated for credit toward a course requirement in psychology.

Study 1: Listing of Basic Level Categories

In their first assignment, subjects were asked to produce categories of emotion at the basic level within a restricted interval. It was assumed that the more prototypical members would be generated first while the less representative members would be recalled later (or not at all). Sixteen of the categories eventually became the key emotions since they were used in additional studies.

Method

The instructions that were provided to subjects ($N = 145$) were very similar to those employed by Fehr and Russell (1948):

This study is part of a larger project on the sorts of things people have in mind when they hear

and use words. We are interested in the kinds of things that might belong to general categories. We will give you the category and you will give us the items that belong to that category. For example, if given the category "SEAFOOD," you might respond with such items as clams, oysters, lobster tails, shrimp salad, pickled herring, and so on.

Now please list as many items of the category "EMOTION" as come readily to mind. We will be timing you, so speed is essential. Stop after you have listed approximately 20 items for the "EMOTION" category. You have about three minutes to list your items. Start now.

Responses were subsequently written down on sheets of plain typing paper until the interval terminated.

Results and Discussion

Only the first four responses were counted to make the data compatible with previous listings (Fehr & Russell, 1984; Hunt & Hodge, 1971). In tallying responses, nouns and adjectives that essentially described the same emotional category were treated equivalently (e.g., anger

and angry; sad and sadness; happy and happiness). Verbs were also coded in this way: depressed was the same response as depression; excited the same as excitement. By collapsing across syntactical form, the total number of different items finally arrived at was 52, with 23 being mentioned by only one subject. A listing of these various emotions along with their frequency-of-occurrence is presented in Table 1.

Insert Table 1 about here

As Table 1 shows, some examples of emotion came very readily to mind while others did not. For instance, the categories happiness, sadness, and anger were generated by more than half of the subjects while boredom, gloom, and hope were listed by only one individual. Other categories apparently fell in between these extremes, signifying that a continuum of prototypicality had been found, even when only four responses were considered.

Sixteen of these basic categories were chosen for further use in subsequent experiments; for this reason, they were regarded as the key emotions. The criterion

for category selection was their variable availability to subjects, ranging anywhere from 68% of the sample mentioning these terms to .7%, which was the lowest percentage occurrence. Provided in Table 2 are the experimental rankings of our 16 key categories, along with the other research listings.

Insert Table 2 about here

Rank-order comparisons were subsequently performed across lists with our categories correlating .83 with Fehr and Russell's recoded scores and .62 with Hunt and Hodge's. A correlation of .69 was also computed between their rankings. All the comparisons were highly significant at the .001 level, suggesting that a basic set of categories could be consistently obtained for the superordinate name emotion.

In regards to this set, the basic types with the highest availability scores (i.e., happiness, sadness, and anger) presumably contained the most prototypical characteristics of emotion while those with the lowest scores (i.e., boredom, calmness, and envy) had the least

characteristics. And based on our data, strong and persistent positive (as well as negative) qualities appeared to be an integral part of this prototype. Three of our eight most frequently occurring categories were ones of a positive nature: happiness, love, and joy. Very few positive types were listed further down the frequency hierarchy, supporting this claim. Thus, the first study undertaken demonstrated that basic and central features of emotion could be identified through a prototype analysis.

Study 2: Generating the Superordinate Category

Given the key emotions that were obtained in the first study, subjects now had to provide the corresponding superordinate name. Our hypothesis that the more prototypical terms would elicit the category "emotion" more often than the other members was derived from Rosch's data (1973a, 1973b) on perceptual and semantic categories, along with similar research that had been conducted with this concept (Fehr & Russell, Experiment 2, 1984). In order to further test the applicability of Rosch's theory to other concepts, natural object items from the categories fruit, sport,

and vehicle were interspersed with the key emotions to determine what superordinates would be generated for these examples as well.

Method

The instructions were an extension of Fehr and Russell's (1984), with particular emphasis made to the listing of only one superordinate name for each term:

This study is part of a larger project on the sorts of things people have in mind when they hear and use words. On this questionnaire, we are interested in the general categories to which things belong. We will give you a word and you will give us the general category. For example, if given the word "carrot," you might write in "vegetable." For the word "mother," you might respond with "female."

The list below gives you a series of items. For each item, your task is to provide the general category to which it belongs. Please use one word for the category you have selected. You may use the same word as often as you wish. Don't worry

about whether your category is right or wrong. There are actually many possible answers. Stop after you have provided all the category names or approximately after three minutes.

Subjects ($N = 127$) received one of four possible questionnaire forms. In version A, 5 of the 16 key emotions were interspersed with 11 other items taken from natural object categories: 4 from "fruits" (apple, strawberry, watermelon, and coconut), 4 from "sports" (football, hockey, bowling, and hiking), and 3 from "vehicles" (car, boat, and sled). These members varied along a scale of prototypicality, as Armstrong et al. (Experiment 1, 1983) demonstrated. In the next form, version B, 5 more of the key emotions were intermingled with these 11 terms. The third form, version C, had the remaining 6 key terms along with 10 of the natural object members. The final version listed all 16 emotions without any other items. The rationale for using a list consisting of all the basic level emotions was so that one superordinate name would not be extensively employed by subjects. The first three versions (A, B, and C) were given to an equivalent number of subjects ($N = 29$) while

version D, the emotion list, was administered to 40 subjects.

Results and Discussion

The results were very encouraging: every key term was considered an emotion as evidenced by the percentage of subjects generating that superordinate name for each one of the 16 terms. Surprisingly, the emotion list elicited the highest percentages, in comparison to the other three versions. As portrayed in Table 3, Fehr and Russell (1984) had found just the reverse trend, that their questionnaires containing filler items (versions 1, 2, and 3) had higher emotion percentages than version 4 which contained all the target emotions.

Insert Table 3 about here

Correlations between their lists and ours, however, still showed significant relationships at the .01 level. The rank-ordered values .54 and .48 were obtained for the emotion lists and the other three forms, respectively. Moreover, Table 3 reveals that the greatest subject

percentages occurred to many of our most available terms (e.g., hate, anger, and love), confirming the hypothesis that more prototypical members would elicit the category "emotion." Other superordinates that were mentioned by at least three subjects for every key term (irregardless of version) were feeling and state. The remaining name affect was stated by one subject for 10 of the 16 key terms on the emotion list and by another for 3 of the 16 on one of the alternate versions. Obviously emotion shares some of the characteristics of feeling and state. In fact, "emotion may [even] be a type of feeling or state" (Fehr & Russel, 1984, p. 471), indicating that emotion, to some degree, is a more basic-level category to these superordinates.

The percentage of subjects mentioning the superordinates fruit, sport, and vehicle for members of these categories was also calculated and compared with the respective Armstrong et al. (1983) prototypicality rating. Their scale ranged from terms being extremely good examples of that category (1) to ones representing extremely poor examples (7). Table 4 provides a listing of these percentages and the corresponding ratings.

Insert Table 4 about here

Though correlations could not be computed on so few terms, a relationship was still demonstrated: namely, more prototypical members were more likely to elicit that superordinate name than peripheral members, again supporting Rosch's theory. Other superordinates common to every member were also elicited by subjects. Food and dessert were given as alternatives to "fruit" by at least three subjects, game in place of "sport" by approximately seven subjects, and transport (followed by machine) for the category "vehicle" by five and two subjects, respectively. Similar to the emotion data, the superordinates that were selected as substitutes apparently were more general level categories under which the names fruit, sport, and vehicle could be placed as members. Based on these consistent findings across various types of categories, we suggest that Rosch's hierarchy be extended perhaps another level "higher" where broader and even more general superordinates are represented.

Study 3: Prototypicality Ratings of Key Emotions

Rather than continuing to use the measure of how readily basic level terms come to mind to assess prototypicality (see Study 1), a more direct means was employed in this third study, namely rating each of the key emotions along a scale of prototypicality to determine how good an example each was of the category emotion. Armstrong et al. (1983) and others (Rosch, 1973a, 1973b, 1975) found that subjects could directly rate category members; moreover, these ratings proved to be reliable over time, especially across lengthy intervals (Fehr & Russell, 1984; McCloskey & Glucksberg, 1978). To correlate our findings with previous ones, we replicated the Fehr and Russell (Experiment 3, 1984) methodology, with the intention of demonstrating a similar pattern of prototypicality for the key emotions.

Method

Subjects ($N = 90$) read the following instructions which were an adaptation of Rosch's (1973a, 1973b), suitable to the rating of key terms belonging to the category "emotion."

This study has to do with what we have in

mind when we hear and use words. Let's consider the word "fruit." Close your eyes and imagine an apple. Next imagine an olive. Although you might still name the olive with the term "fruit" this is not as good an example as apple. Apple is more fruity than olive.

Notice that to judge how good an example something is has nothing to do with how much you like the thing. You might personally prefer an olive to an apple, but still recognize which is the better example of "fruit" — namely, the apple.

In this particular study, the word we are interested in is "emotion." We are interested in which experiences or feelings are good or poor examples of "emotion." On the back side [of this sheet] is a list of 24 terms. We would like you to rate the extent to which each feeling on the list is a good or poor example of "emotion." You have as much time as you want to rate the feelings.

Don't worry about why you feel that something is or isn't a good example of "emotion." And don't worry about whether it's just you or

people in general who feel that way. Just mark the feeling the way you see it.

Subjects rated each of the 24 terms on a 6-point scale, extending from an extremely poor example (1) of an emotion to an extremely good example (6). The terms were listed in the same order for all subjects. Sixteen of these were the key emotions; the remaining eight members were randomly chosen from the list of basic emotion categories presented in Table 1.

To determine test-retest reliability of these ratings, the identical listing was readministered to the same group of subjects ($N = 79$) 7 months later. The major prediction was that subjects would show consistency in their ratings, even over such an extended period.

Results and Discussion

Mean prototypicality ratings for the 24 emotion terms at Times 1 and 2 appear in Table 5.

Insert Table 5 about here

The correlation between times was .88 ($p < .001$), indicating high subject consistency even when a smaller

group was retested 7 months later. With respect to the emotions themselves, subjects regarded the terms love, happiness, and anger as the most typical examples while melancholy, boredom, and calmness were considered among the least prototypical. The other terms extended along a broad range of prototypicality, from more to less representative instances.

The 16 key emotions were subsequently compared with the Fehr and Russell items. As evidenced in Table 6, ratings were shown to be reliable across samples of subjects and retest intervals.

Insert Table 6 about here

Our ratings correlated .70 with Fehr and Russell's at Time 1 and .68 at Time 2, ($p < .001$), suggesting that a similar continuum of prototypicality ranging from love to calmness had been identified in both studies.

Finally, to determine whether prototypicality of each category was in fact related to that category's availability, correlations were computed on these ratings and the respective frequency-of-occurrence scores from

Study 1. Significant rank-ordered values of .66 and .64 ($ps < .001$) were obtained at Times 1 and 2. Obviously, availability and direct rating of the key categories converged on the same dimension of emotion, namely its internal structure, and demonstrated good evidence for its validity.

Study 4: Reaction Times of Key Emotions

Another way to assess the typicality of various members of categories has been to measure the subject's response times in their verification of statements taking the form "An [exemplar] is a [category name]." Rosch (1973) and others (Mervis & Rosch, 1981, Shoben & Smith, 1973; Rosch et al, 1976) have shown that true category membership statements involving highly prototypical members (e.g., A robin is a bird) are verified more quickly than less typical exemplars (e.g., A pelican is a bird). Performance in these speed tasks have also correlated quite well with the direct prototypicality ratings. Fehr, Russell and Ward's (1982) set of target emotions apparently followed this trend: more central terms were identified as emotions faster than peripheral types. The same prediction was therefore hypothesized

for our list of 16 key terms. In an attempt to generalize our findings to other categories, statements containing fruit and sport members were interspersed with the emotion terms. Moreover, false category membership statements were used to determine if a similar reaction time pattern would occur with the central and peripheral items, though results from previous research were not encouraging (Fehr et al., 1982).

Method

Subjects ($N = 60$) were ushered into the laboratory and asked to read the following instructions, which were borrowed from McCloskey and Glucksberg (1978):

This is a study of the 'belongingness' of items in categories. You will be presented with a series of statements. Each statement will contain a pair of words of the form 'X is a/an Y.' The second word in each pair, the Y, is a category name and the first word, the X, represents something which may or may not be a member of that category. If the word is a member of the category. (e.g.,

'Dog is a mammal'), you should respond YES as fast as you can. If the word is not a member of the category (e.g., 'Car is a tool') you should respond NO as fast as you can.

You will now hear a series of 88 statements. For each statement, simply respond YES or NO. For some statements, this will be ridiculously easy; it will be perfectly clear that the word is or is not a member of the category. For other statements, however, the situation may not be so clear-cut, and it may be difficult to make a decision. Again simply give what seems to you to be the best answer. It should be emphasized that you must make a yes-no decision for each statement, whether or not it seems clear-cut to you. Your response will be timed with a stopwatch so try to respond as quickly and as accurately as you can.

In order to prepare subjects for each trial, the experimenter used the prompt 'NEXT' before he read them that sentence. Subjects' response times were measured

to the exact hundredth-of-a-second by an electronic stopwatch provided by Lafayette Instruments Company (Model Number 14705XP).

The pool of statements that were employed consisted of 32 emotion sentences and 56 'other category' sentences, specifically pertaining to the concepts fruit and sport. The sentences for each category were divided in terms of membership typicality and truth value. For instance, the concept of emotion was referred to in: (1) 8 true central statements such as "Happiness is an emotion," (2) 8 true peripheral statements such as "Boredom is an emotion," (3) 8 false central statements such as "Love is a science," and (4) 8 false peripheral statements such as "Worry is a bird." These emotion statements were composed from our 16 key terms, 8 which had been rated as most typical and the remaining 8 which were rated less typical (see Study 3).

Similar sentence versions were derived for the fruit and sport categories. The Armstrong et al. (1983) prototypicality ratings determined the level of membership in these categories. The 7 central fruit terms that were selected consisted of the following: apple, plum, orange, cherry, pear, banana, and pineapple.

The 7 more peripheral fruit items were strawberry, prune, apricot, fig, olive, watermelon, and coconut. With respect to the sport category, more typical members were football, hockey, gymnastics, baseball, basketball, soccer, and wrestling. The other 7 members considered to be less typical were fishing, diving, archery, weight-lifting, fencing, bowling, and hiking.

The fruit and sport statements were designed to replicate previous findings (Fehr et al., 1982; Rosch 1973) and to provide filler items for the task. Subjects took approximately 20 minutes to respond to the entire pool of sentences.

Results and Discussion

Reaction times were recorded only for correct responses. A response was considered correct if the subject responded Yes to a true central or peripheral statement and No to a false central or peripheral statement. The mean number of correct responses along with the corresponding reaction times for each type of sentence belonging to the emotion, fruit, and sport categories are presented in Table 7.

Insert Table 7 about here

With respect to the category emotion, a dependent sample t -test revealed that true central statements were verified more quickly than ones containing peripheral members, $t(59) = 5.87, p < .001$. Number correct also differed between these statements, $t(59) = 3.14, p < .01$. Reaction time differences were not evidenced, however, between central and peripheral false emotion statements.

The fruit and sport categories elicited similar verification trends. Subjects responded "yes" more quickly to true central fruit statements than they did to true peripheral statements, $t(59) = 2.68, p < .01$, as well as ones containing more central sport members, $t(59) = 2.94, p < .01$. Moreover, number correct analyses replicated the emotion data, with central fruit and sport items eliciting better performance. These results confirmed reaction-time findings specifically executed by Fehr et al. (1982) and others (Rosch, 1973).

It would appear that subjects were more certain that central members belonged to the appropriate category than they were peripheral members, as shown by faster

verification times and greater number correct responses. Presumably, these items shared more of the concept's prototypical features and thus could be responded to with less deliberation and hesitation. Since these differences were not found with false category statements, one might conclude that typicality of the members did not influence these recognitions. Perhaps subjects were at a disadvantage in this condition since they had to generate the correct superordinate name for central and peripheral members alike before they reached a "yes-no" decision. Sometimes the false superordinate was so misleading (e.g., Love is a science; Joy is a sport) that subjects showed delayed reaction times with these central items as they searched for the appropriate category. In comparison, the superordinate was already provided for each true category statement and so subjects had to simply give the appropriate response. Thus, less information processing was required on the subjects' part with these latter sentences, possibly contributing to the effects of prototypicality on reaction-time performance here. It should be noted that faster verifications occurred with true statements in comparison

with false ones across categories, supporting this interpretation.

Study 5: Substitutability of Key Emotions

Previous research by Rosch (1977) as well as Fehr and Russell (1984) have demonstrated that prototypicality ratings are not only good predictors of verification performance but also of substitutability of category members for their superordinates. When subjects were asked to judge sentences where the superordinate name (e.g., fruit) was replaced by a member of that category (apple or watermelon), those statements that had the most prototypical terms were rated as most natural sounding (e.g., A bowl of apples makes a nice centerpiece for the table), whereas those sentences that had the least representative terms were rated as very peculiar sounding (e.g., A bowl of watermelons makes a nice centerpiece for the table). These findings are quite consistent with the prototype perspective which suggests that more central examples are closer in meaning to the superordinate due to their possessing many of the categorical features, and hence can be more

effectively replaced for that superordinate in sentences without losing their natural sounding quality.

To more directly apply these findings to the concept of emotion, we asked subjects to rate sentences which originally contained the term emotion on a naturalness-peculiarity scale. In each of the sentences, one of the 16 key emotions was substituted for the superordinate. All of the original sentences were taken from recently published introductory psychology textbooks in order to obtain the most objective and precise descriptions of the concept emotion. For this reason, subjects were not allowed to write their own sentence versions as had been incorporated in other methodologies (Fehr & Russell, Experiment 4, 1984; Rosch, 1977).

Method

Subjects ($N = 320$) were given the following instructions before they performed the rating assignment:

This questionnaire is part of a larger project on the sorts of things people have in mind when they hear and use words. In this study, we are interested in how peculiar or how

natural certain sentences sound. For example, the sentence "Twenty or so sparrows often perch on the telephone wires outside my window and twitter in the morning" probably sounds quite natural to most people. On the other hand, a sentence like "Twenty or so turkeys often perch on the telephone wires outside my window and twitter in the morning" sounds rather peculiar. In this study, we are not interested in sentences about birds. Rather, we are interested in how peculiar or natural sentences about particular emotions sound.

Below is a series of sentences — some make a lot of sense, others make some sense, and some make no sense at all. Your task is to read each sentence to yourself and rate how natural or peculiar it sounds to you. You will be using a 6-point scale in your rating, with a "1" representing a very peculiar sounding sentence and a "6" representing a very natural sounding sentence.

Don't spend time wondering if your answer is right or wrong. There are no right or wrong answers, so just base your response on your first impression from reading the sentence. You have approximately 5 minutes to perform this task.

The 16 original sentences that were rated are listed in Table 8.

Insert Table 8 about here

Each subject received a questionnaire containing this set of sentence frames in which one of the 16 key terms was substituted for the word emotion. Selection of key terms was done in such a way that each one appeared only once on a given questionnaire. Thus, a total of 16 questionnaire forms was generated, and an equivalent number of subjects ($n = 20$) was exposed to each version. A naturalness score was subsequently obtained for each key emotion by taking the mean rating across the 16 sentences.

Results and Discussion

As evidenced in Table 9, substitutability scores varied for particular emotions: happiness, excitement, love, and anger substitutes produced the most natural sounding sentences while pride, boredom, and calmness substitutes elicited the most peculiar sounding sentences. A rank-order correlation of .50 between our scores and Fehr and Russell's further indicated that a similar pattern of substitutability had been found for the key emotions.

Insert Table 9 about here

These naturalness scores were then compared with the prototypicality ratings obtained in Study 3 and were shown to correlate highly with this measure, $r_s = .85$, $p < .001$. The results, therefore, supported our hypothesis that the more typical a key term was of the category emotion, the more effectively the term could be substituted for the superordinate name in a sentence without losing the intended meaning.

To further confirm our conclusions, correlations

were computed between the naturalness and prototypicality scores of key emotions for each one of the 16 sentence frames. Table 8 shows the calculated coefficient alongside each sentence. Though the range of correlations extended from .36 to .71, all were in the expected direction and once again demonstrated that more prototypical examples produced more natural sounding sentences. Lower coefficients with particular sentences might be explained by the fact that these descriptions of emotion had stronger negative connotations. Statements like 'Emotion is sometimes uncontrollable and unpredictable' and 'Strong emotion can disrupt performance and impair thinking' were so emotion-specific that even highly prototypical positive substitutes (i.e., love and happiness) sounded peculiar upon replacement. Fehr and Russell (1984) suggest that textbook writers might be defining emotion on various levels of prototypicality, with the end result being that some authors are more exact than others. Consistent with this interpretation, descriptions involving feelings, arousal, facial expressions, and even cognitive processes (which seem applicable to many of the key

emotions) generated the stronger correlations.

Study 6: Inductive Generalizations
With Key Emotions

Another hypothesis generated by the prototype perspective is that people would be able to more effectively generalize features of central members to peripheral instances than vice versa. In one experiment (Rips, 1975), subjects that were told horses (more prototypical mammals) had a new type of contagious disease were willing to infer that other, less prototypical species of mammal (e.g., mice) would be infected. However, subjects were less likely to generalize the same disease to horses when told the mice had the infection. Additional research with other categories (Rips, Shoben, & Smith, 1973) would seem to confirm this trend of inductive reasoning from central to peripheral members. In this current study, particular scenarios involving a key emotion were read by subjects who then had to determine how likely other emotions would be experienced in the same situation. The major prediction was that statements pertaining to central emotions would differ from ones involving more

peripheral instances due to subjects being restricted in their generalizations with the latter types.

Method

Before being presented with the statement of the problem situation, subjects ($N = 180$) read the following instructions:

In this study we are interested in how people decide which members of a category are most similar to each other, and which members are least similar. For instance, if you are told that "all eagles have contracted a certain disease," you would be able to more readily state that "all hawks have this disease" than you would "all ostriches". Hawks are more similar to eagles than ostriches, and so you would more than likely generalize the disease to this group of related birds.

The category of interest in this study is emotion. You will read a paragraph specifically applying to one emotional state. Then you will be shown a list of eight emotions which you will compare to the given state. You are asked to

estimate the proportion of people experiencing that particular emotion in the space provided to the right. Your estimates should be made on a scale extending from 0 to 100 percent, with the stipulation that your percentage judgments should not all be equal. Don't worry about whether your percentages are right or wrong. Just base your estimate on your first impression from reading the provided text.

Subjects were then given a typewritten sheet that asked them to imagine people being placed in sensory deprivation chambers. They were told that these people frequently experienced intense hallucinations along with an accompanying emotional state. The subjects' task was to provide an estimate of the proportion of sensorially deprived people experiencing hallucinations for eight other emotional (or target) instances. Subjects were equally divided into groups so that each group ($n = 20$) received only one Given Textual Instance. Also, the Given Instance appeared among the list of Target Instances that other groups had to estimate. The set of emotions that were selected varied in prototypicality, with five being more central members

and four representing more peripheral instances. A total of nine emotion forms were subsequently generated, with different random orders of the Target Instances provided to each group.

Results and Discussion

Mean percentage judgments were calculated for each of the Target Instances across emotion forms.

Insert Table 10 about here

A nonsignificant correlation was obtained ($r = -.43$), indicating that generalizations did not differ when either central or peripheral emotions were used as the Given Instance. It should be noted, however, that there was a trend for the coefficient to follow the expected direction.

We then decided to examine subjects' generalizations on each form individually in order to more effectively determine any possible relationships between Target Instance and type of Textual Instance given (whether central or peripheral). Judgment percentages were averaged for each Target on a given form and were

subsequently correlated with those on the remaining forms.

Insert Table 11 about here

As Table 11 shows, a definite pattern emerged. Positive target correlations were found when Given Instances shared the same membership. More importantly, inverse relationships were obtained when more peripheral Given Instances were contrasted with highly central ones. Now, some cases did not particularly conform to the latter finding (e.g., depression). Perhaps subjects were confused in their prediction-making when some instances were not as strongly representative of their respective category as others. Remember that depression received a prototypicality rating of 4.64, which was substantially lower than other central emotions, such as love and happiness.

Overall, the separate form analyses indicated partial support of the Roschian hypothesis, namely that generalization to Target Instances differed when typicality of the Given Instance changed from centrality

to peripherality (i.e., from love to guilt). As illustrated in the major correlation matrix, one significant factor that affected subjects' judgments was the highly positive quality of the Given Instance, whether it was love, happiness, or joy. Subject generalizations were presumably harder with more peripheral examples which did not contain this feature.

Study 7: Family Resemblance Scores With Key Emotions

Finally, Rosch and Mervis (1975) have demonstrated that the most prototypical members of a category have the highest family resemblance scores. That is, the better examples resemble other instances of that category (or family) due to their possessing attributes that can be shared by many more members. With respect to emotion, Fehr and Russell (1984) discovered that "increase in heart rate" activity was the most shared attribute in their target list (characteristic of 16 of the 20 emotions), while "unconcerned with appearance" was the least shared attribute (listed for only one emotion). More specifically, excitement, fear, and anxiety generated the highest family resemblance scores;

boredom and calmness, on the other hand, had the lowest number of attributes. Further, family resemblance correlated positively with the prototypicality rating received by each member. The purpose of this study was to replicate these findings with our list of key emotions as well as to identify a new series of shared attributes for this particular category. Attribute listing and subsequent derivation of family resemblance scores followed the procedure as outlined by Rosch and Mervis (1975).

Method

The instructions provided to subjects ($N = 140$) consisted of the following:

This is a very simple experiment to find out the characteristics and attributes that people feel are common to psychological experiences, specifically emotions. For example, if you were asked to list the characteristics of a person experiencing madness, you might write:

- out of touch with reality
- dangerous to himself and others
- incomprehensible speech

- 'crazy' actions
- insane thoughts
- psychotic
- wild-eyed
- maniacal laughter
- contorted face
- sweaty forehead and palms
- outstretched arms
- aggressive body posture
- trembling hands
- rapid heart beats
- heavy breathing

On the following handout, a number of emotions are listed. For each emotion, you will have approximately two minutes to write down all of the characteristics of that particular state that you can think of (similar to what we just did with madness). Include the obvious in your descriptions. And try not to just free associate. For instance, if "madness" makes you think of Anthony Perkins or a relative, don't write down Mr. Perkins or grandmother. We are only interested in what is common to instances of that particular emotion.

We do not want specific types of characters.

Subjects were equally divided into groups, with each group ($n = 35$) receiving a different set of four key emotions: two central terms and two peripheral. In order to derive a measure of family resemblance, all the attributes that subjects had mentioned for each emotion were listed. Two undergraduate psychology students reviewed the overall table and judged which attributes they considered false (e.g., 'Friday, the Thirteenth' for fear; 'beer money' for excitement; 'Mel Brooks' for happiness) as well as which ones they perceived to be characteristic of another key term. Further elimination of attributes occurred if judges were uncertain or disagreed on particular characteristics. Each of the remaining attributes received a weighted value ranging from 1 to 16, which represented the total number of emotions credited with that descriptor. The degree of family resemblance possessed by each key emotion was then obtained by specifically taking the sum of these weighted attributes listed for each item.

Results and Discussion

The total number of responses generated by subjects

was 1,564. After particular attributes were eliminated, 390 reponses were left that were mentioned at least twice, either for the same emotion or for different emotions. Each of these 390 attributes was then weighted. Once again, the highest weighted attribute was "heart-rate increase" (12) since this characteristic was shared by 12 of the 16 emotions. Other attributes that were common to at least half of the set of key emotions were: "nervous disposition" (11), "tears/crying" (10), "large eyes" (10), "rapid breathing" (9), "upset stomach" (9), "anxious feeling" (9), "tense muscles" (8), and "sweaty palms" (8). It should be noted that most of these attributes resembled the ones commonly listed by the Fehr and Russell subjects. The least-weighted characteristics contained less arousing features; some included "completely relaxed", "at peace", "no facial expressions", "still", "yawning", "almost asleep/sleeping".

Based on these weighted attributes, a family resemblance score was then calculated for each key emotion. These scores are listed in Table 12, along with the ones obtained in Fehr and Russell's (1984)

target set.

Insert Table 12 about here

Not only did our scores significantly correlate with previous data ($r_s = .50$, $p < .01$), but they also showed a strong relationship with their respective prototypicality rating ($r_s = .58$, $p < .001$). These results definitely provide further confirmation of the Rosch and Mervis (1975) findings, namely that more typical members possess more shared attributes. Thus, another reliable measure of a category's internal structure is the degree to which examples resemble each other along a familial continuum.

Study Comparisons

The more direct measures of prototypicality (i.e., availability of terms, probability of generating the category name, ratings involving goodness of example, substitutability of members for the category name, and family resemblance scores) were subsequently compared in a correlation matrix.

Insert Table 13 about here

Reaction-time data and inductive judgments were excluded from the major analysis due to these studies focusing on other outcomes beside typicality (e.g., truth value of statements; generalization to Target Instances, whether central or peripheral). Moreover, only a limited number of key emotions (9) were used as Given Textual Instances in the generalization study (Study 6), and so a proper comparison with the entire set of items could not be performed here.

As indicated in Table 13, all but one measure of prototypicality (i.e., family resemblance) were highly intercorrelated. The range of these correlations extended from .49 to .97 for the raw scores and from .39 to .85 for the rank orders. This high level of consistency among the various measures is a good indicator that emotion does have an internal structure which is prototypically arranged in terms of good to poor examples.

The exception to this trend was the family

resemblance measure which demonstrated occasionally modest intercorrelations, especially with availability and superordinate listing (.20 and .32 on raw scores respectively; .30 and .26 on ranks respectively). Though the latter findings contrast with Rosch and Mervis's (1975), they are in agreement with the Fehr and Russell (1984) results. It might be the case that it is harder to articulate the attributes of particular emotions than the characteristics of everyday objects (Fehr & Russell, p. 480). Or perhaps family resemblance is not a suitable measure to reflect the typicality of all emotion members.

General Discussion

Based on our series of studies, it would appear that the concept of emotion follows a Roschian type of membership classification similar to other natural object categories (such as fruit, sport, and vehicle). Subjects were not only able to rank members of emotion according to "goodness of example" but also showed the expected consistency in their ratings over time. Even more importantly, prototypicality ratings (Study 3) correlated strongly with other measures of internal

structure: availability of members, substitutability of members for the superordinate, and finally, family resemblance scores.

It is necessary to point out that the prototype perspective was not applicable to every trend shown in the data. Specifically, central items did not improve reaction-time performance with false category statements (Study 4) and did not produce a distinctly different pattern of generalization from the peripheral types (Study 6), indicating that the best example of emotion remained the prototype itself. However, as Fehr and Russell (1984) comment, the advantage of employing a prototype analysis in the study of emotion is that such a perspective still provides relevant information on "how a person can use and can understand the concept [of emotion or any natural object category] without explicitly possessing a classical definition [which often times proves inadequate even when formulated]" (p. 481).

One benefit derived from the prototype approach is that a list of important descriptors can be generated for the emotion category. All of our central members possessed the following prototypic

characteristics: intense arousal, deep feelings, as well as positive or negative qualities arranged in an opponent fashion to other members. With respect to the former features, some of the most prototypical emotions shared attributes which contained very arousing features (e.g., heart-rate increase, rapid breathing, and sweaty palms) as well as possessed more natural-sounding descriptions which involved "stirred up" states of mind and body, feelings, and facial expressions. Moreover, every positive central emotion had as its complement a corresponding negative member: love with hate, happiness with depression, and joy with anger (or envy). Interestingly, our number of central terms (8) replicated previous emotion set sizes postulated by Izard (1971) and Plutchik (1962, 1980). Even Fehr and Russell's (1984) list of most representative emotions numbered ten, which was consistent with the 'eight plus or minus two' research criterion. Obviously these primary sets contained the most prototypical features of emotion and therefore should be regarded as the most basic-level types of emotion.

We suggest that future studies should more effectively concentrate on the subordinate levels of

emotion (e.g., various types of anger and love).

Though the best examples may not be found here, it would be interesting to employ the same measures of internal structure for comparison purposes with the basic-level types. In this way, Rosch's theory would be further validated with categories other than natural object.

We should acknowledge that our postulated prototypic arrangement is only applicable to concepts of emotion rather than to the actual events which elicit emotions per se. Only by knowing the specifics of the situation can one determine whether an event has prototypical or peripheral elements. Nonetheless, it is evident that the prototype perspective remains a valid theory in the area of concept research, particularly with the category of emotion. Our studies definitely showed consistent trends with the Fehr et al. (1982, 1984) experiments, supporting the psychological reality of the "internal structure" to concepts. Though other competing approaches have been proposed (Brooks, 1978; Smith & Medin, 1981), none have provided the empirical data that the prototype analysis has done in the attempt to specify the taxonomy of categories (whether emotion or

natural object). Apparently the classical theory, at its best, has only limited usefulness to particular categories. So any new concepts that are developed, such as in script research (Abelson, 1982), might conform more appropriately to this framework of goodness of example.

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Table 1

Listing of Basic Level Categories

Happiness (99)	Lust (4)	Calmness (1)
Sadness (92)	Sorrow (4)	Surprise (1)
Anger (79)	Melancholy (4)	Dislike (1)
Love (63)	Ecstasy (4)	Stressed (1)
Hate (48)	Pride (4)	Irritated (1)
Fear (29)	Anxiety (3)	Trust (1)
Depression (22)	Unhappy (3)	Envy (1)
Joy (19)	Guilt (3)	Hysterical (1)
Frustration (13)	Rage (2)	Solemn (1)
Jealousy (12)	Scared (2)	Aggravated (1)
Mad (9)	Bitterness (2)	Hope (1)
Exuberant (8)	Thrilled (2)	Aggressive (1)
Excitement (8)	Worry (1)	Disappointment (1)
Sympathetic (7)	Boredom (1)	Infatuation (1)
Glad (6)	Serenity (1)	Despise (1)
Nervous (5)	Gloom (1)	Grief (1)
Greed (4)	Strife (1)	Euphoria (1)
		Flight (1)

70 Note: The number in parentheses is the number of subjects, out of 145, who listed each item.

Table 2
Percentage of Subjects Who Listed Each of 16 Categories of Emotion

Category	Study 1 ^a		Fehr & Russell (1984) ^a		Hunt & Hodge (1971) ^b	
	Rank	%	Rank	%	Rank	%
Happiness	1	68.3	1	51.0	4	29.75
Sadness	2	63.4	3	42.5	6	22.75
Anger	3	54.5	2	49.0	5	27.75
Love	4	43.4	4	38.5	2	52.25
Hate	5	33.1	6	19.5	3	44.50
Fear	6	20.0	5	24.5	1	53.25
Depression	7	15.2	9	4.0	8	7.50
Joy	8	13.1	7	13.0	7	15.75
Excitement	9	5.5	8	6.5	10	5.00
Pride	10	2.8	15	0	14.5	0.75
Anxiety	11.5	2.1	10	3.5	9	7.00
Guilt	11.5	2.1	11	3.0	13	1.25
Worry	14.5	0.7	12	1.5	14.5	0.75
Bored	14.5	0.7	15	0	16	0
Calmness	14.5	0.7	15	0	11	2.00
Envy	14.5	0.7	13	0.5	12	1.50

Note: Study 1, $N = 145$; Fehr & Russell, $N = 200$; Hunt & Hodge, $N = 400$

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^aFirst four responses. ^bFour responses.

Table 3

Percentage of Subjects Providing the Superordinate Name Emotion for 16 Key Terms

Category	<u>Study 2</u>		<u>Fehr & Russell (1984)</u>	
	Version D	Version A,B,C	Version 4	Versions 1,2,3
Hate	79.3	16.1	35.7	50.0
Fear	79.3	24.2	25.0	33.3
Anger	75.9	25.0	28.6	46.7
Love	72.4	25.3	50.0	50.0
Joy	72.4	21.8	32.1	46.7
Happiness	62.1	26.6	32.1	56.7
Depression	62.1	15.3	28.6	10.0
Envy	62.1	24.3	25.0	30.0
Sadness	58.6	22.6	35.7	60.0
Pride	58.6	9.7	25.0	3.3
Anxiety	58.6	24.3	21.4	30.0
Guilt	55.2	14.5	25.0	26.7
Excitement	51.7	27.4	21.4	30.0
Calmness	48.3	16.9	10.7	6.7
Worry	44.8	15.3	25.0	26.7
Boredom	44.8	13.7	10.7	3.3

74 Note. Percentages are given separately for the emotion list and the other three versions.

Table 4

Percentage of Subjects Providing Superordinate
Names Along With Corresponding Prototypicality
Ratings for Natural Object Categories

Category	%	M ^a
Fruit		
Strawberry	80.4	2.1
Apple	69.0	1.3
Watermelon	56.3	2.9
Coconut	21.8	4.8
Sport		
Football	78.2	1.4
Hockey	72.4	1.8
Bowling	63.2	4.4
Hiking	32.2	4.6
Vehicle		
Car	82.6	1.0
Boat	67.8	3.3
Sled	28.7	5.2

^aMean prototypicality ratings extended along a scale from
extremely good example (1) to extremely poor example (7).

Table 5

Mean Prototypicality Ratings for 24 Emotion Terms

Category	Time 1		Time 2	
	Rank	M	Rank	M
Love	1	5.41	1	5.53
Happiness	2	5.10	2	5.39
Anger	3	5.01	3	4.93
Excitement	4	4.97	4	4.76
Hate	5	4.76	6	4.53
Depression	6	4.64	8	4.48
Joy	7	4.63	5	4.60
Sorrow	8	4.60	9	4.39
Sadness	9	4.58	10	4.20
Frustration	10	4.50	13	4.09
Anxiety	11	4.40	11	4.17
Mad	12	4.24	12	4.14
Fear	13	4.20	7	4.50
Surprise	14	4.11	14	3.87
Guilt	15	3.88	15	3.72
Worry	16	3.80	16	3.53
Disappointment	17	3.74	21	3.12
Bitterness	18	3.71	18	3.47
Pride	19	3.62	17	3.48
Irritation	20	3.54	20	3.24
Envy	21	3.50	19	3.30
Melancholy	22	3.28	22	2.92
Boredom	23	2.66	24	2.26
Calmness	24	2.40	23	2.59

Note. Ratings were made from extremely poor example (1) to extremely good example (6).
At Time 1, N = 90; at Time 2, 7 months later, N = 79.

Table 6
Mean Prototypicality Ratings for Key Emotions

Category	Study 3		Fehr & Russell (1984)	
	Time 1	Time 2	Time 1 ^a	Time 2 ^b
Love	5.41	5.53	5.46	5.27
Happiness	5.10	5.39	5.00	4.51
Anger	5.01	4.93	5.15	5.36
Excitement	4.97	4.76	4.58	4.47
Hate	4.76	4.53	5.26	5.04
Depression	4.64	4.48	4.73	4.58
Joy	4.63	4.60	4.89	4.93
Sadness	4.58	4.20	5.04	4.49
Anxiety	4.40	4.17	4.29	4.44
Fear	4.20	4.50	4.78	5.00
Guilt	3.88	3.72	4.55	4.55
Worry	3.80	3.53	3.84	3.96
Pride	3.62	3.48	3.33	3.51
Envy	3.50	3.30	4.13	4.26
Boredom	2.66	2.26	2.71	2.76
Calmness	2.40	2.59	2.75	2.82

^aAt Time 1, $N = 55$. ^bAt Time 2, 5 months later, $N = 53$.

Table 7

Mean Reaction Time (in Hundredths of Seconds) in the
Category Verification Task

	Mean Reaction Time	Mean N Correct
<u>Emotion Statements</u>		
True Central	54	7.2
True Peripheral	62	6.4
False Central	60	6.8
False Peripheral	58	6.7
<u>Fruit Statements</u>		
True Central	56	6.3
True Peripheral	62	5.7
False Central	61	6.1
False Peripheral	58	6.3
<u>Sport Statements</u>		
True Central	51	6.2
True Peripheral	56	5.4
False Central	59	5.8
False Peripheral	58	5.6

Note. Maximum possible number correct for emotion statements = 8.00; maximum number correct for fruit (and sport) statements = 7.00.

Table 8

Correlation Between Substitutability and Prototypicality

Sentence	Correlation
1. Emotion is a personal, private, and subjective experience.	.67**
2. One who experiences emotion is extremely energetic and motivated.	.45**
3. Emotion is sometimes uncontrollable and unpredictable.	.37*
4. Emotion involves an aroused state of mind accompanied by feelings.	.71**
5. Human emotion is far more complex and intricate than animal emotion.	.42*
6. Emotion should not interfere with reasoning ability.	.52**
7. Sometimes expressing strong emotion leaves one in an immobilized state.	.49**
8. Facial features often reflect the emotion one is experiencing.	.68**

Table continues

9. Emotion is extremely complex because it has so many different aspects and is used in so many different ways. .56**
10. Some people tend to show more emotion than others. .51**
11. Emotion accompanies goal-oriented behavior. .39*
12. Emotion is very hard to define; emotion is an experience one cannot put into words. .71**
13. Strong emotion can disrupt performance and impair thinking. .39*
14. It is hard to be close to someone who shows no emotion. .45**
15. In reaching a decision, the person should not be swayed by his/her emotions. .36*
16. Emotion involves a complex pattern of changes including physiological arousal, feelings, cognitive processes, and behavioral reactions. .66**

Note. All sentences were taken from introductory psychology textbooks. * $p < .05$, ** $p < .01$, one-tailed.

Table 9

Mean Naturalness Scores for 16 Key Emotions

Category	<u>Study 5^a</u>		<u>Fehr & Russell^b</u>	
	Score	Rank	Score	Rank
Happiness	4.82	1	4.10	7.5
Excitement	4.75	2	4.60	1
Love	4.72	3	4.10	7.5
Anger	4.68	4	4.30	3.5
Joy	4.39	5	4.20	5
Hate	4.29	6	4.10	7.5
Anxiety	4.22	7.5	4.30	3.5
Depression	4.22	7.5	3.80	14
Fear	4.20	9	4.40	2
Sadness	4.08	10	3.90	12.5
Worry	3.70	11	4.00	10.5
Guilt	3.63	12	4.10	7.5
Envy	3.52	13	3.90	12.5
Pride	3.29	14	4.00	10.5
Boredom	3.00	15	3.30	15

Table continues

Calmness	2.64	16	3.00	16
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Note. ^aStudy 5, N = 320. ^bFehr & Russell, N = 400.
 Scores in Study 5 are means across 16 sentences. The
 score for each sentence was a mean across 20 subjects
 on a rating scale from very peculiar (1) to very
natural (6).

Table 10

Inductive Judgment Percentages for Emotion Forms

Emotion	Form	
	Central	Peripheral
Love	51.04	21.12
Happiness	44.68	26.25
Anger	47.51	36.82
Depression	49.61	36.44
Joy	49.38	20.48
Guilt	20.67	28.50
Worry	32.97	53.57
Pride	24.12	34.44
Boredom	27.67	47.20

Note. Percentages shown are means across forms.

Table 11

Correlations Among Given Instance Forms, Involving
Inductive Judgments

Form	1	2	3	4	5	6	7	8	9
1. Love	.88**	.92**	.57	.34	-.66*	-.37	-.24	-.02	
2. Happiness		.66**	.38	.69*	-.89*	-.61	-.51	-.53	
3. Anger			.33	.60	-.48	-.39	-.28	-.02	
4. Depression				-.03	.04	.16	.59	.40	
5. Joy					-.84*	-.38	-.45	-.67*	
6. Guilt						.67*	.87**	.75**	
7. Worry							.92**	.90**	
8. Pride								.89**	
9. Boredom									

Note. Correlations were calculated by obtaining mean judgment percentages across 20 subjects for each emotion.

* $p < .05$; ** $p < .01$, one-tailed.

Table 12

Family Resemblance Scores for 16 Key Emotions

Category	<u>Study 7^a</u>		<u>Fehr & Russell^b</u>	
	Score	Rank	Score	Rank
Excitement	342	1	283	1
Love	326	2	202	10
Anxiety	291	3	248	4
Fear	265	4	274	2
Happiness	248	5	200	11
Depression	216	6	224	6
Hate	208	7	188	12
Guilt	206	8	217	8
Joy	193	9	220	7
Worry	185	10	261	3
Anger	176	11	246	5
Sadness	174	12	155	13
Envy	171	13	132	14
Pride	139	14	211	9
Boredom	105	15	112	15

Table continues

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Calmness	98	16	111	16
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Note. ^aStudy 7, N = 140. ^bFehr & Russell, N = 40.

The score for each emotion was obtained by taking the sum of its weighted attributes.

Table 13

Correlations Among Measures of Prototypicality

Measures	Studies				
	1	2	3	5	7
1. Availability of terms ^a		.49	.66	.62	.20 ⁺
2. Listing superordinate ^b	.51		.61	.59	.32 ⁺
3. Prototypicality rating ^c	.66	.51		.97	.75
5. Substitutability ^d	.53	.39	.85		.79
7. Family Resemblance ^e	.30 ⁺	.26 ⁺	.58	.61	

Note. Correlations were calculated across 16 target emotions listed in Table 2. Correlations above the diagonal are based on raw scores; those below the diagonal are based on ranks.

⁺Not significant at alpha = .05, one-tailed, $N = 16$.

^aItem's frequency based on first four responses (Study 1).

^bPercentage of subjects giving emotion as the superordinate

(Study 2). ^cRatings extended from extremely poor to

extremely good examples (Study 3). ^dRatings extended

from very peculiar to very natural sounding sentences

(Study 5). ^eScores based on sum of each emotion's

weighted attributes (Study 7).